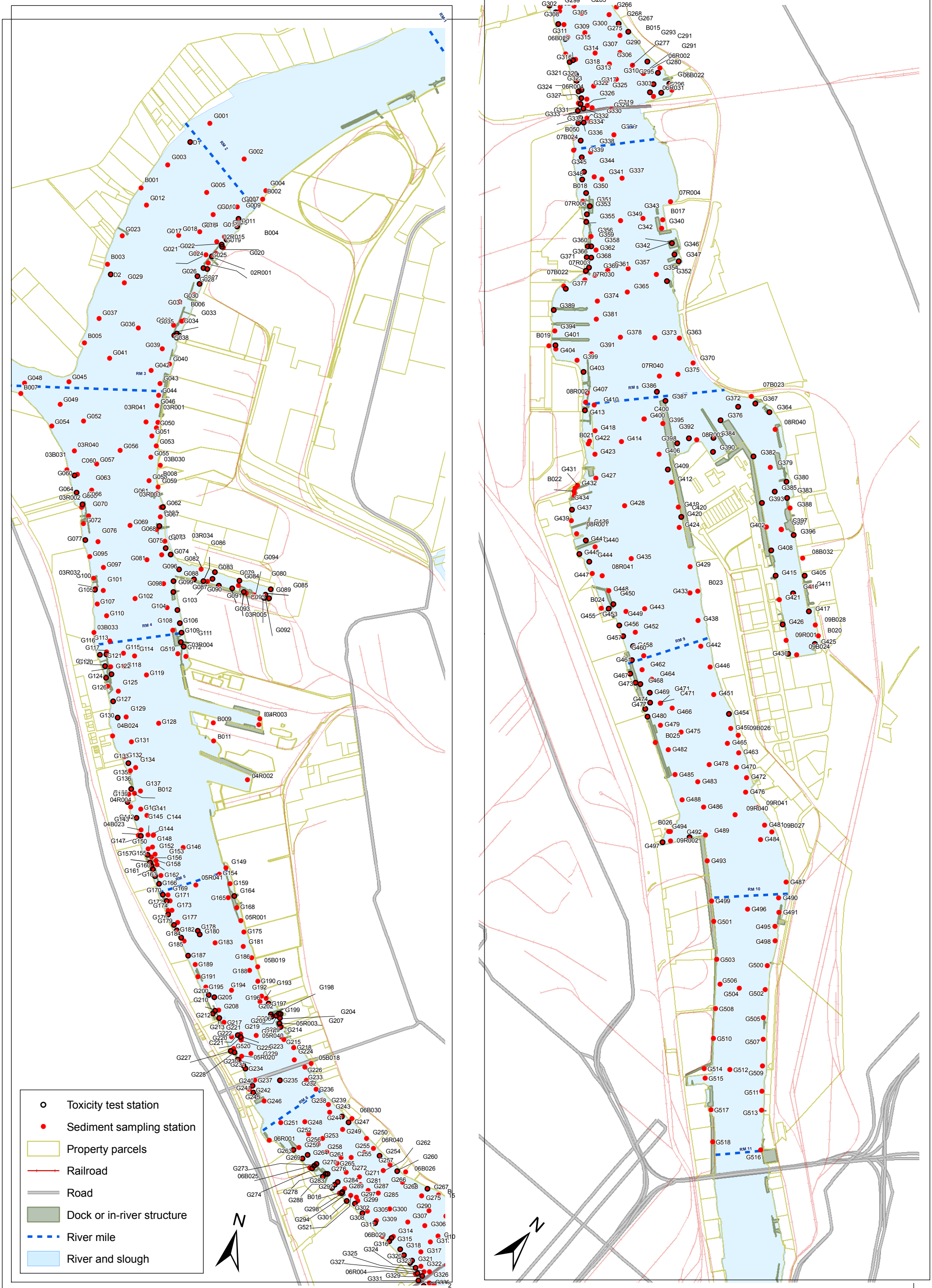

Figure 2-1. Portland Harbor Round 1 and 2 surface sediment and Round 2 toxicity test stations River Miles 2 to 11

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W:\Projects\01-25-01 Portland Harbor ERA\Data\GIS\Bioassay\Surface sediment and toxicity test stations

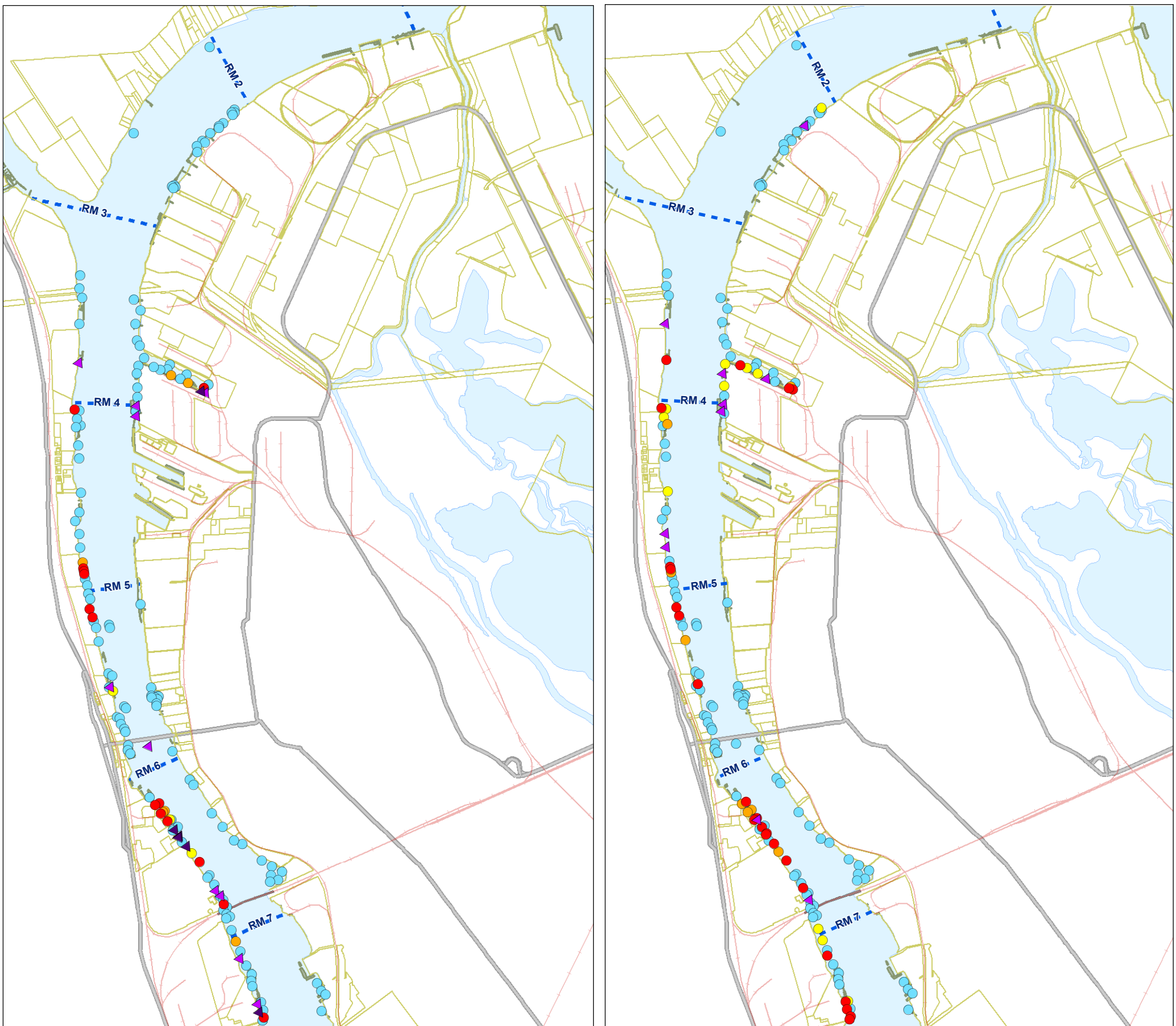

Figure 2-2. Toxicity test hit/no-hit and indeterminate stations for *Chironomus*

0 0.25 0.5 1 1.5 Miles

0 0.5 1 2 Kilometers

N

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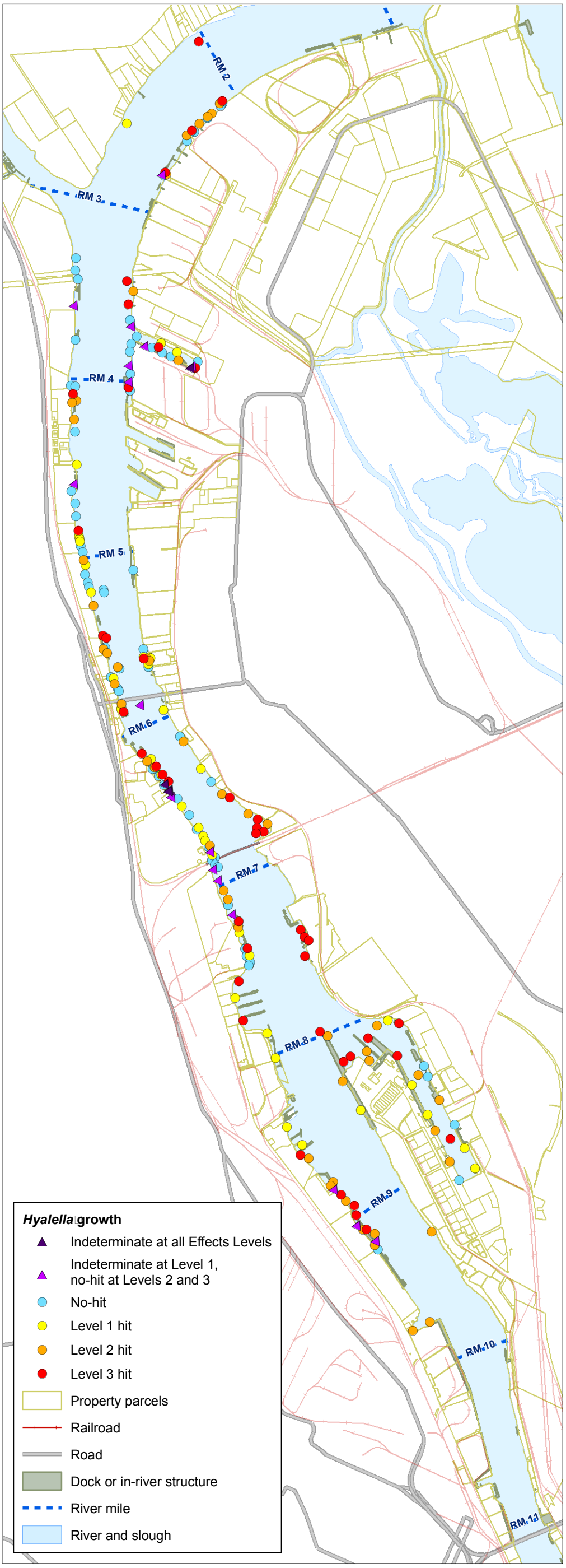
W:\Projects\01-25-01 Portland Harbor ERA\Data\GIS\Bioassay\



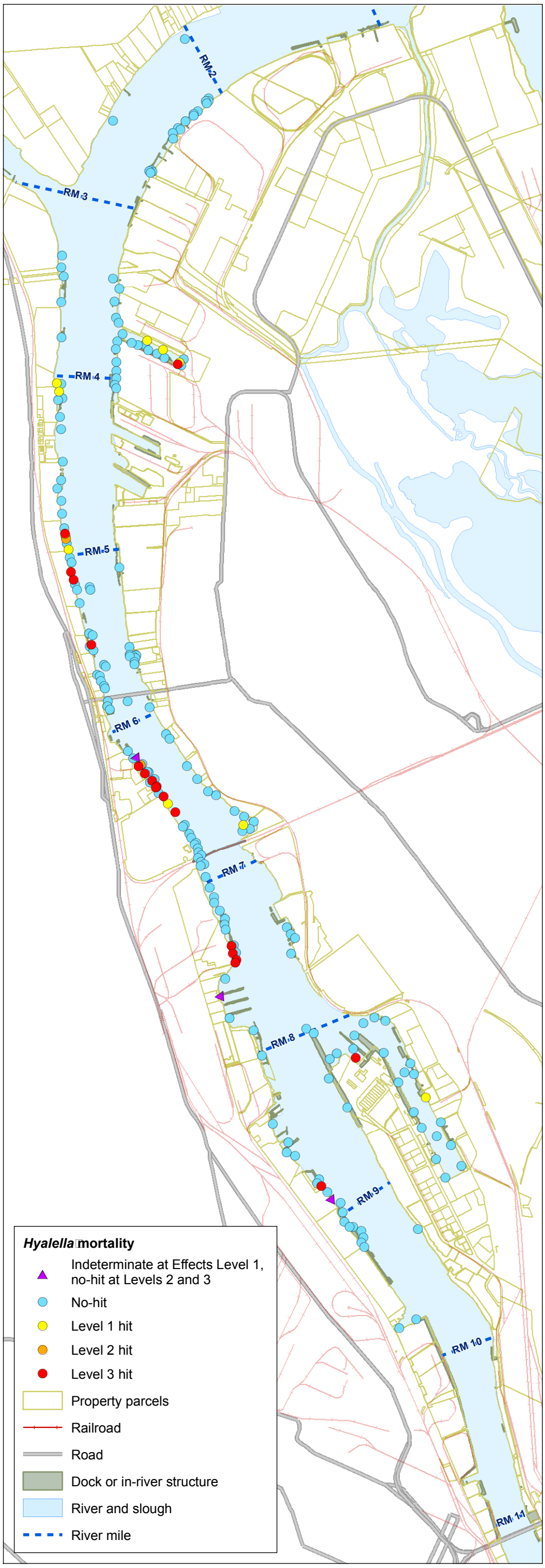


Figure 2-3. Toxicity test hit/no-hit and indeterminate stations for *Hyalella*

0 0.25 0.5 1 1.5 Miles

0 0.5 1 2 Kilometers

N

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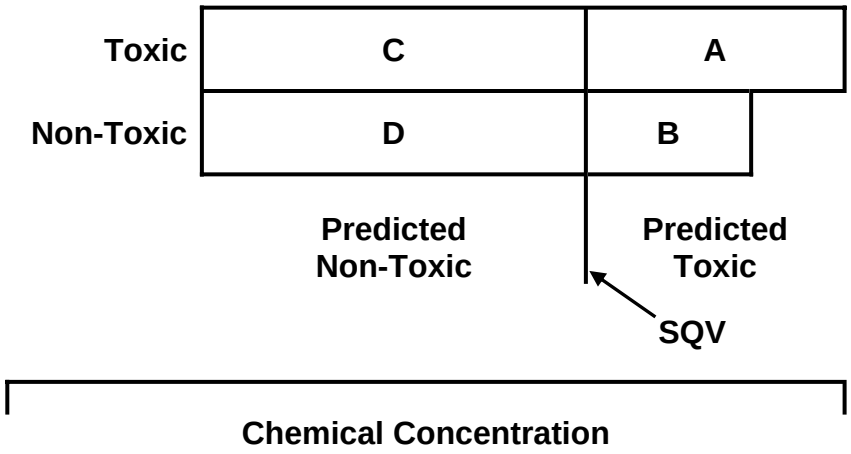


False negatives = C/(A+C)
False positives = B/(B+D)
Sensitivity = A/(A+C)
Efficiency = D/(D+B)
Predicted hit reliability = A/(A+B)
Predicted no-hit reliability = D/(D+C)
Overall reliability = (D+A)/(A+B+C+D)

Figure 3-1. Calculation of reliability parameters

Figure 4-1. Correlations that have a significant Pearson's correlation coefficient

		Conventional				HPAH										
Group	Chemical	Fines (%)	TOC	Ammonia	Sulfide	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Indeno(1,2,3-c,d)pyrene	Pyrene	Total HPAHs (calc'd)
Conventional	Fines (%)															
	TOC															
	Ammonia															
	Sulfide															
HPAH	Benzo(a)anthracene						x	x	x	x	x	x	x	x	x	x
	Benzo(a)pyrene					x		x	x	x	x	x	x	x	x	x
	Benzo(b)fluoranthene					x	x		x	x	x	x	x	x	x	x
	Benzo(g,h,i)perylene					x	x	x		x	x	x	x	x	x	x
	Benzo(k)fluoranthene					x	x	x	x		x	x	x	x	x	x
	Chrysene					x	x	x	x	x		x	x	x	x	x
	Dibenz(a,h)anthracene					x	x	x	x	x	x		x	x	x	x
	Fluoranthene					x	x	x	x	x	x	x		x	x	x
	Indeno(1,2,3-c,d)pyrene					x	x	x	x	x	x	x	x		x	x
	Pyrene					x	x	x	x	x	x	x	x	x		x
HPAH sum	Total HPAHs (calc'd)					x	x	x	x	x	x	x	x	x	x	
LPAH	2-Methylnaphthalene															
	Acenaphthene					x					x		x		x	x
	Acenaphthylene					x	x	x	x	x	x	x	x	x	x	x
	Anthracene					x	x	x	x	x	x	x	x	x	x	x
	Fluorene					x	x	x		x	x	x	x		x	x
	Naphthalene															
	Phenanthrene					x	x	x	x	x	x	x	x	x	x	x
	Total LPAHs (calc'd)					x	x	x	x	x	x	x	x	x	x	x
PAH sum	Total PAHs (calc'd)					x	x	x	x	x	x	x	x	x	x	x
Pesticide	Carbazole					x		x		x	x	x	x		x	x
Misc. organic	Dibenzofuran					x					x		x		x	x
Metal	Aluminum															
	Antimony															
	Arsenic															
	Cadmium															
	Chromium															
	Copper															
	Lead															
	Mercury															
	Nickel															
	Selenium															
	Silver															
	Zinc															
Misc. organic	Hexachlorobenzene															
	Total dioxins/furans (calc'd)															
	Total PCBs Aroclors (calc'd)															
Organotin	Dibutyltin															
	Monobutyltin															
	Tetrabutyltin															
	Tributyltin															
PAH sum	Diesel-Range Hydrocarbons															
Pesticide	Aldrin															
	alpha-Hexachlorocyclohexane															
	beta-Hexachlorocyclohexane															
	delta-Hexachlorocyclohexane															
	Methoxychlor															
	Total chlordane (calc'd)															
	Total DDTs (calc'd)															
	Total endosulfan (calc'd)															
Phenol	4-Methylphenol															
	Pentachlorophenol															
	Phenol															
Phthalate	Bis(2-ethylhexyl) phthalate															
	Butyl benzyl phthalate															
	Di-n-butyl phthalate															

		LPAH								PAH sum	Pesticides	Misc. Organic
Group	Chemical	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Total LPAHs (calc'd)	Total PAHs (calc'd)	Carbazole	Dibenzofuran
Conventional	Fines (%)											
	TOC											
	Ammonia											
	Sulfide											
HPAH	Benzo(a)anthracene		x	x	x	x		x	x	x	x	x
	Benzo(a)pyrene			x	x	x		x	x	x		
	Benzo(b)fluoranthene			x	x	x		x	x	x	x	
	Benzo(g,h,i)perylene			x	x			x	x	x		
	Benzo(k)fluoranthene			x	x	x		x	x	x	x	
	Chrysene		x	x	x	x		x	x	x	x	x
	Dibenz(a,h)anthracene			x	x	x		x	x	x	x	
	Fluoranthene		x	x	x	x		x	x	x	x	x
	Indeno(1,2,3-c,d)pyrene			x	x			x	x	x		
	Pyrene		x	x	x	x		x	x	x	x	x
HPAH sum	Total HPAHs (calc'd)		x	x	x	x		x	x	x	x	x
LPAH	2-Methylnaphthalene		x	x	x	x	x	x	x	x		x
	Acenaphthene	x			x	x		x	x	x		x
	Acenaphthylene	x			x			x	x	x		
	Anthracene	x	x	x		x		x	x	x	x	x
	Fluorene	x	x		x			x	x	x		x
	Naphthalene	x							x			
	Phenanthrene	x	x	x	x	x			x	x		x
	Total LPAHs (calc'd)	x	x	x	x	x	x	x		x		x
PAH sum	Total PAHs (calc'd)	x	x	x	x	x		x	x		x	x
Pesticide	Carbazole				x					x		
Misc. organic	Dibenzofuran	x	x		x	x		x	x	x		
Metal	Aluminum											
	Antimony											
	Arsenic											
	Cadmium											
	Chromium											
	Copper											
	Lead											
	Mercury											
	Nickel											
	Selenium											
	Silver											
	Zinc											
Misc. organic	Hexachlorobenzene											
	Total dioxins/furans (calc'd)											
	Total PCBs Aroclors (calc'd)											
Organotin	Dibutyltin											
	Monobutyltin											
	Tetrabutyltin											
	Tributyltin											
PAH sum	Diesel-Range Hydrocarbons											
Pesticide	Aldrin											
	alpha-Hexachlorocyclohexane											
	beta-Hexachlorocyclohexane											
	delta-Hexachlorocyclohexane											
	Methoxychlor											
	Total chlordane (calc'd)											
	Total DDTs (calc'd)											
	Total endosulfan (calc'd)											
Phenol	4-Methylphenol											
	Pentachlorophenol											
	Phenol											
Phthalate	Bis(2-ethylhexyl) phthalate											
	Butyl benzyl phthalate											
	Di-n-butyl phthalate											

		Metal											Misc. Organic		
Group	Chemical	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc	Hexachlorobenzene	Total Dioxin Furans (calc'd)	Total PCBs Aroclors (calc'd)
Conventional	Fines (%)														
	TOC														
	Ammonia														
	Sulfide														
HPAH	Benzo(a)anthracene														
	Benzo(a)pyrene														
	Benzo(b)fluoranthene														
	Benzo(g,h,i)perylene														
	Benzo(k)fluoranthene														
	Chrysene														
	Dibenz(a,h)anthracene														
	Fluoranthene														
	Indeno(1,2,3-c,d)pyrene														
	Pyrene														
HPAH sum	Total HPAHs (calc'd)														
LPAH	2-Methylnaphthalene														
	Acenaphthene														
	Acenaphthylene														
	Anthracene														
	Fluorene														
	Naphthalene														
	Phenanthrene														
	Total LPAHs (calc'd)														
PAH sum	Total PAHs (calc'd)														
Pesticide	Carbazole														
Misc. organic	Dibenzofuran														
Metal	Aluminum														
	Antimony														
	Arsenic														
	Cadmium														
	Chromium														
	Copper														
	Lead														
	Mercury														
	Nickel														
	Selenium														
	Silver														
	Zinc														
Misc. organic	Hexachlorobenzene														
	Total dioxins/furans (calc'd)														
	Total PCBs Aroclors (calc'd)														
Organotin	Dibutyltin														
	Monobutyltin														
	Tetrabutyltin														
	Tributyltin														
PAH sum	Diesel-Range Hydrocarbons														
Pesticide	Aldrin														
	alpha-Hexachlorocyclohexane														
	beta-Hexachlorocyclohexane														
	delta-Hexachlorocyclohexane														
	Methoxychlor														
	Total chlordane (calc'd)														
	Total DDTs (calc'd)														
	Total endosulfan (calc'd)														
Phenol	4-Methylphenol														
	Pentachlorophenol														
	Phenol														
Phthalate	Bis(2-ethylhexyl) phthalate														
	Butyl benzyl phthalate														
	Di-n-butyl phthalate														

		Organotin				PAH sum	Pesticides								Phenol			Phthalate		
Group	Chemical	Dibutyltin	Monobutyltin	Tetrabutyltin	Tributyltin	Diesel-Range Hydrocarbons	Aldrin	alpha-Hexachlorocyclohexane	beta-Hexachlorocyclohexane	delta-Hexachlorocyclohexane	Methoxychlor	Total Chlordane (calc'd)	Total DDTs (calc'd)	Total Endosulfan (calc'd)	4-Methylphenol	Pentachlorophenol	Phenol	Bis(2-ethylhexyl) phthalate	Butyl benzyl phthalate	Di-n-butyl phthalate
Conventional	Fines (%)																			
	TOC																			
	Ammonia																			
	Sulfide																			
HPAH	Benzo(a)anthracene																			
	Benzo(a)pyrene																			
	Benzo(b)fluoranthene																			
	Benzo(g,h,i)perylene																			
	Benzo(k)fluoranthene																			
	Chrysene																			
	Dibenz(a,h)anthracene																			
	Fluoranthene																			
	Indeno(1,2,3-c,d)pyrene																			
	Pyrene																			
HPAH sum	Total HPAHs (calc'd)																			
LPAH	2-Methylnaphthalene																			
	Acenaphthene																			
	Acenaphthylene																			
	Anthracene																			
	Fluorene																			
	Naphthalene																			
	Phenanthrene																			
	Total LPAHs (calc'd)																			
PAH sum	Total PAHs (calc'd)																			
Pesticide	Carbazole																			
Misc. organic	Dibenzofuran																			
Metal	Aluminum																			
	Antimony																			
	Arsenic																			
	Cadmium																			
	Chromium																			
	Copper																			
	Lead																			
	Mercury																			
	Nickel																			
	Selenium																			
	Silver																			
	Zinc																			
Misc. organic	Hexachlorobenzene																			
	Total dioxins/furans (calc'd)																			
	Total PCBs Aroclors (calc'd)																			
Organotin	Dibutyltin		x																	
	Monobutyltin	x																		
	Tetrabutyltin				x															
	Tributyltin			x																
PAH sum	Diesel-Range Hydrocarbons													x						
Pesticide	Aldrin																			
	alpha-Hexachlorocyclohexane																			
	beta-Hexachlorocyclohexane																			
	delta-Hexachlorocyclohexane																			
	Methoxychlor																			
	Total chlordane (calc'd)																			
	Total DDTs (calc'd)																			
	Total endosulfan (calc'd)					x										x				
Phenol	4-Methylphenol																			
	Pentachlorophenol													x						
	Phenol																			
Phthalate	Bis(2-ethylhexyl) phthalate																			
	Butyl benzyl phthalate																			
	Di-n-butyl phthalate																			

This figure summarizes the correlations that have a significant Pearson's correlation coefficient (minimum r: 0.9; maximum p value: 0.01).
Note: Only the upper triangle of the original matrix was filled; see intersections of rows and columns for important correlations with each chemical.

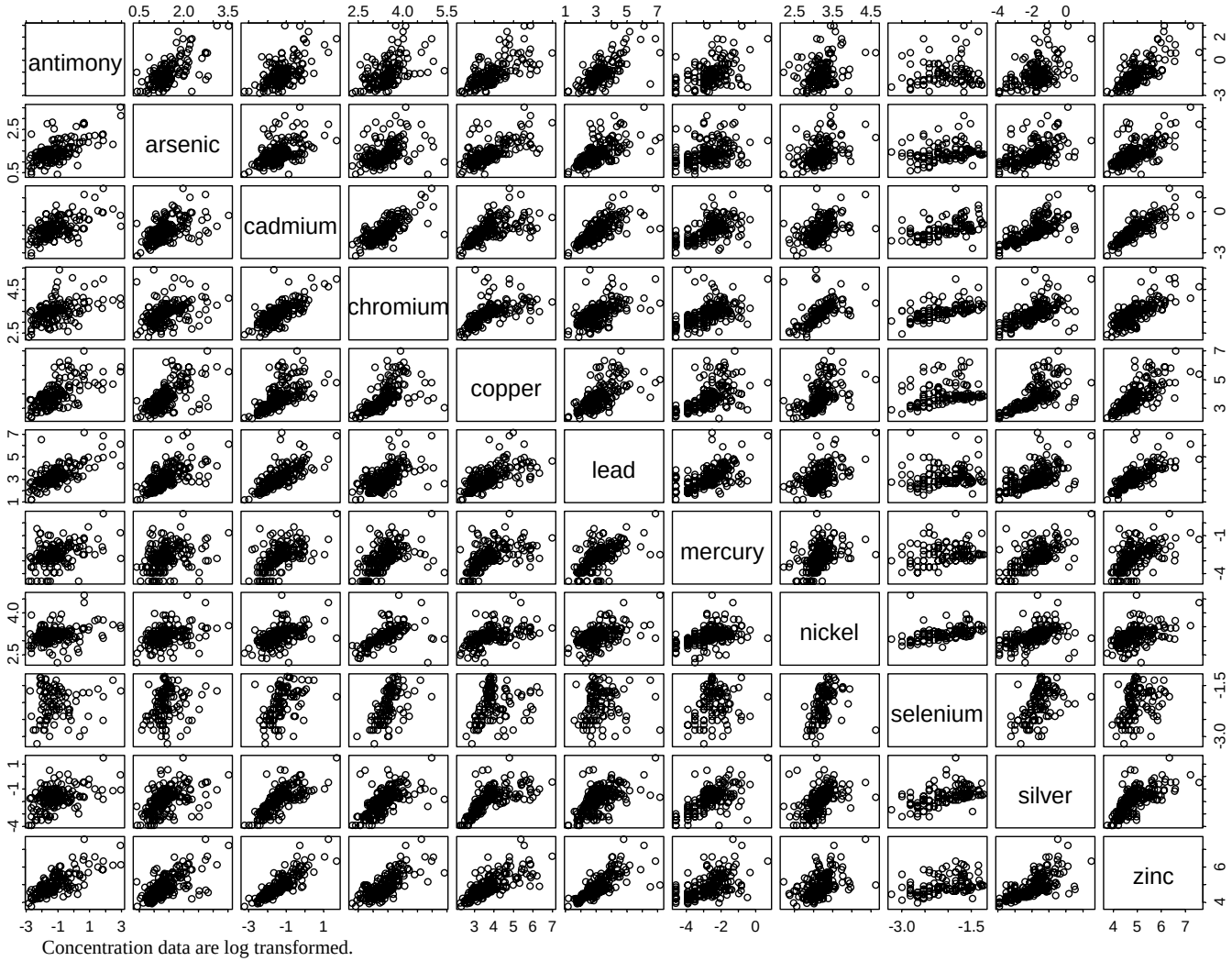
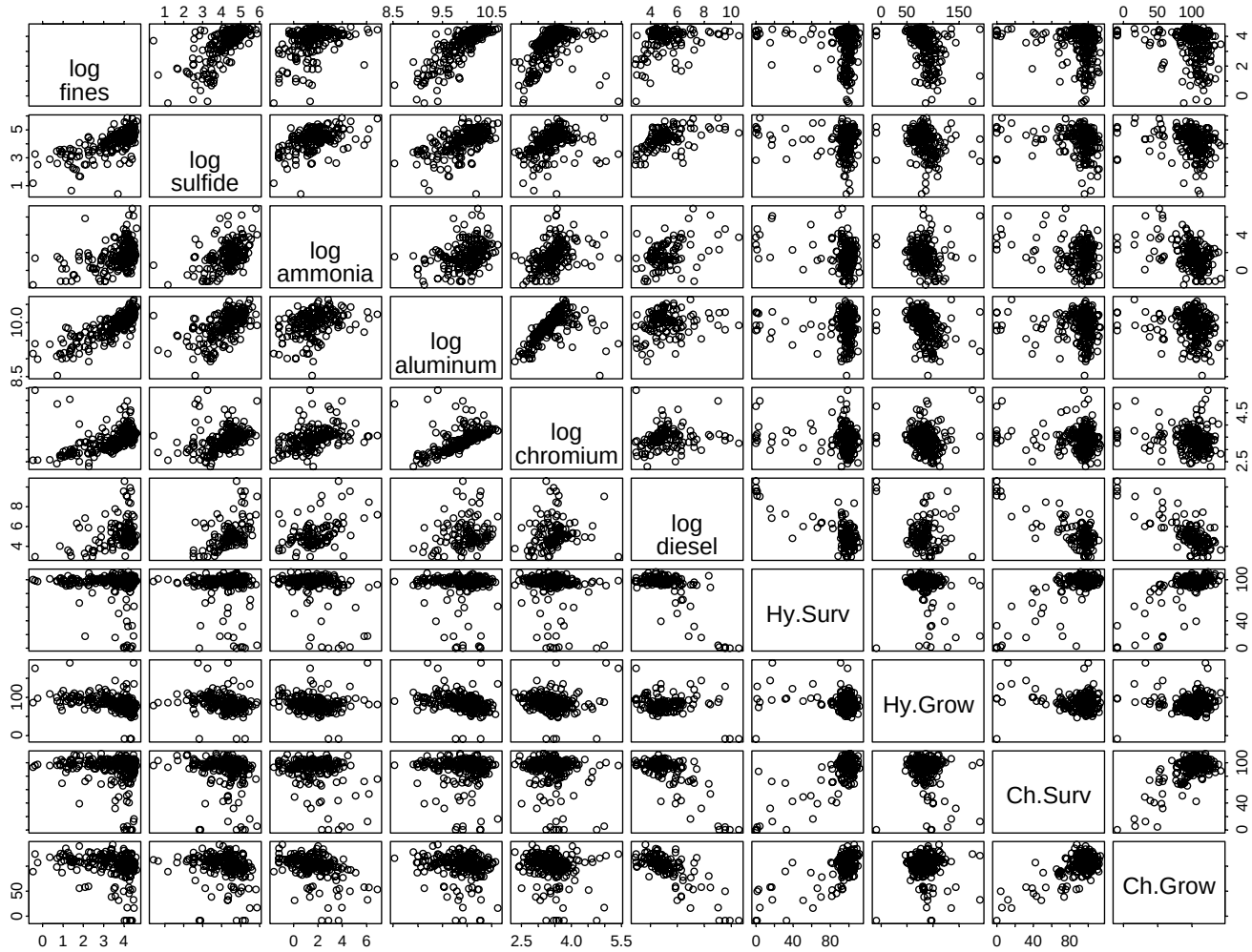


Figure 4-2. Pairwise scatter plots for metals



Biological endpoints were control adjusted; skewed chemical analytes were natural-log-transformed.

Figure 4-3. Pairwise scatter plots for biological endpoints and selected chemical and physical analytes

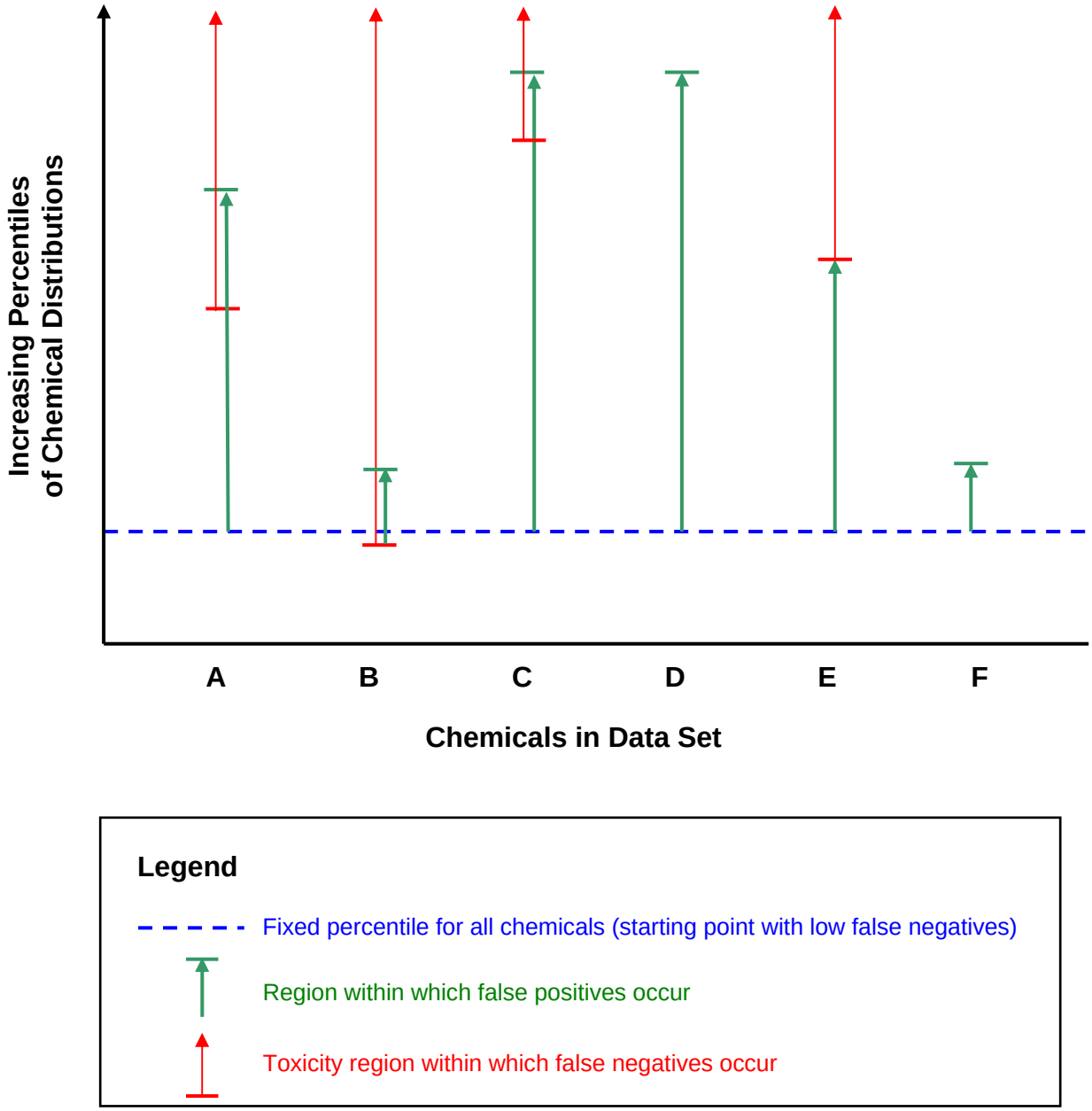


Figure 5-1. Floating percentile model

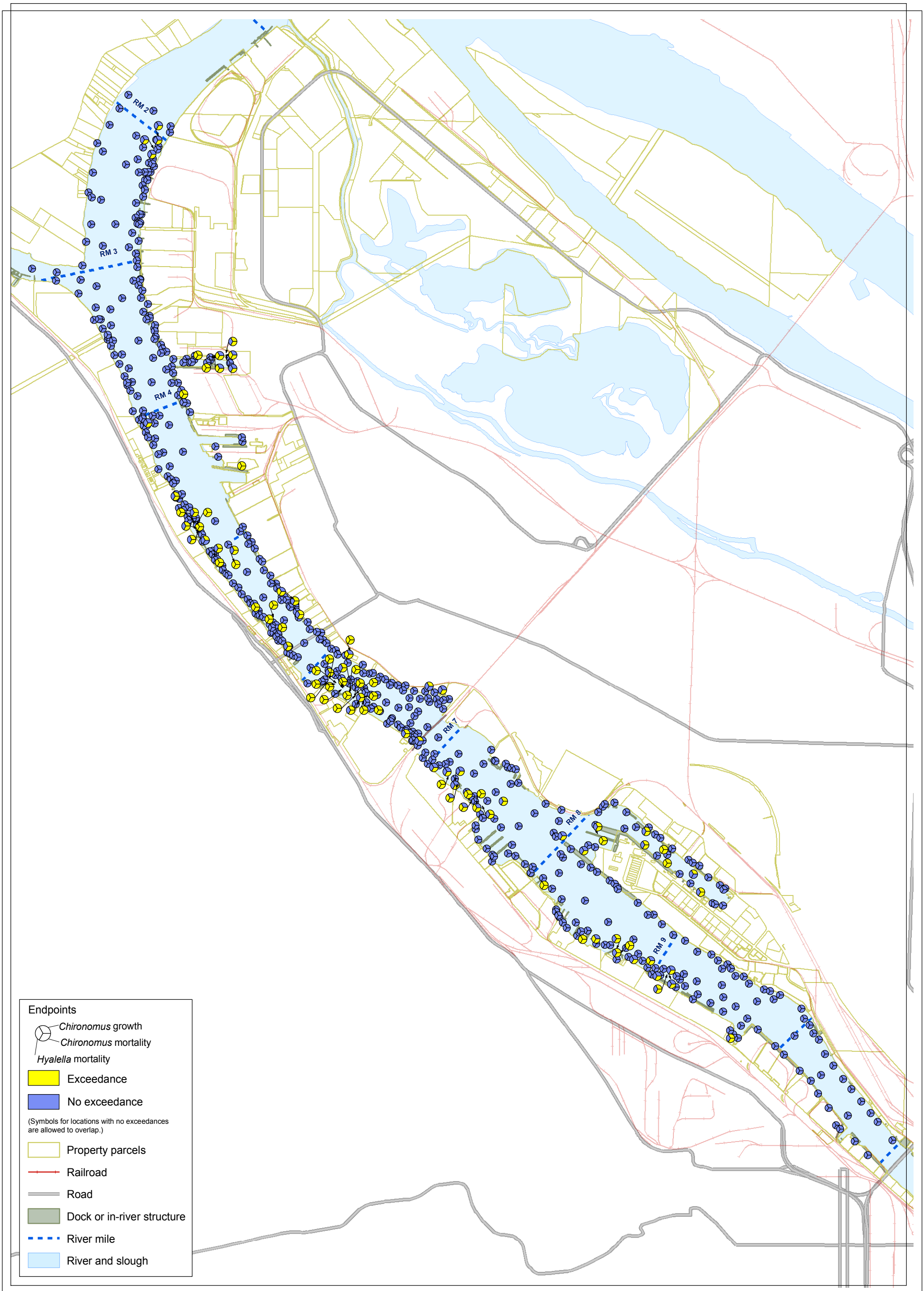


Figure 5-2. Exceedance of Effects Level 2 predicted by floating percentile model

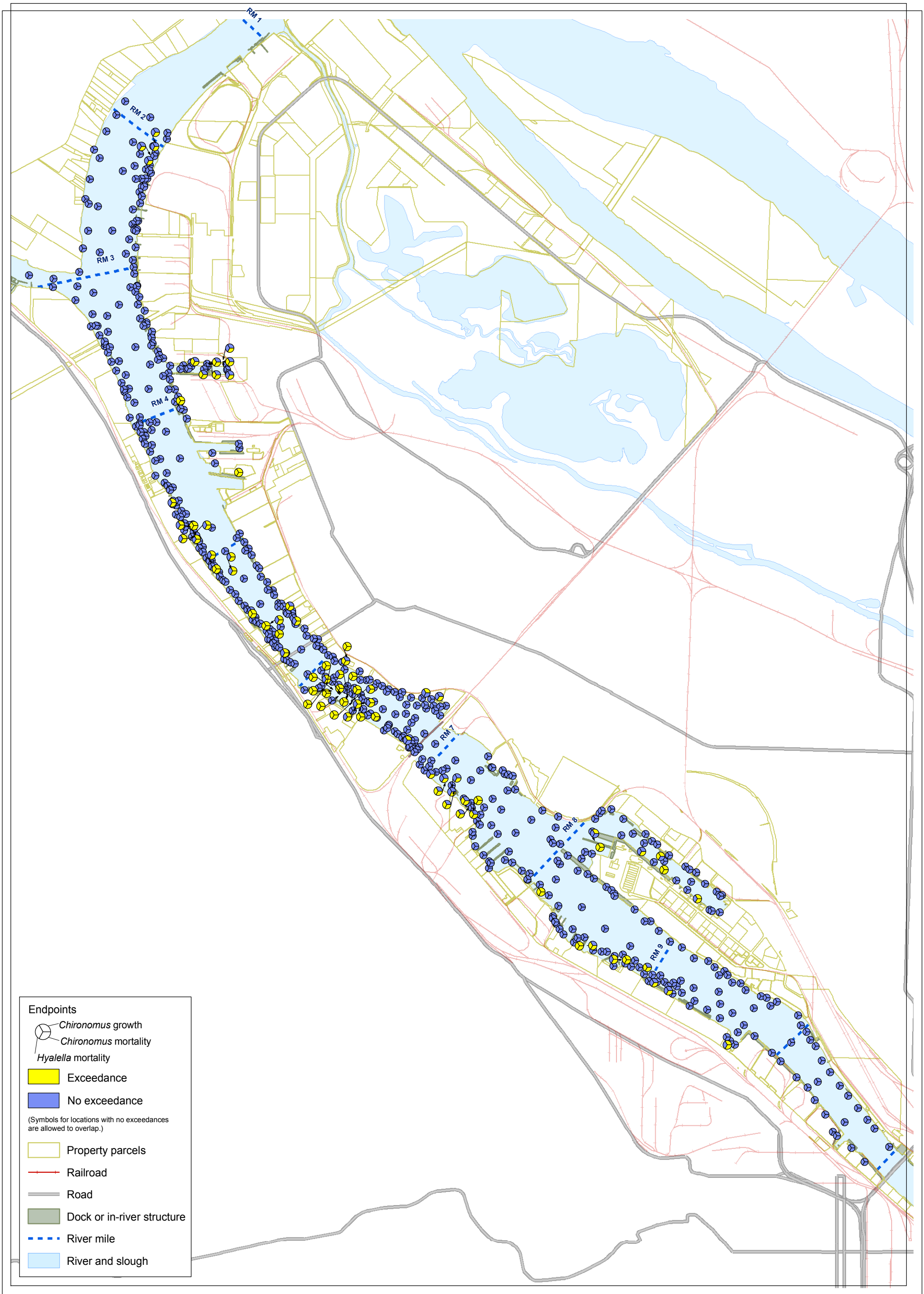


Figure 5-3. Exceedance of Effects Level 3 predicted by floating percentile model

RM 2
RM 3
RM 4
RM 5
RM 6
RM 7
RM 8
RM 9
RM 10

Prediction compared to test result at Effects Level 2

- *Chironomus* growth
- *Chironomus* mortality
- *Hyalella* mortality
- False positive
- False negative
- No error

(Symbols for locations with no errors are allowed to overlap.)

- Railroad
- Property parcels
- Road
- Dock or in-river structure
- River mile
- River and slough

Figure 5-4. Floating percentile model false positive and false negative errors at Effects Level 2

0 0.25 0.5 1 Miles

0 0.5 1 2 Kilometers

N

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RM 2
RM 3
RM 4
RM 5
RM 6
RM 7
RM 8
RM 9
RM 10

Prediction compared to test result at Level 3

Chironomus growth
Chironomus mortality
Hyalella mortality
False positive
False negative
No error
(Symbols for locations with no errors are allowed to overlap.)
Railroad
Property parcels
Road
Dock or in-river structure
River mile
River and slough

Figure 5-5. Floating percentile model false positive and false negative errors at Effects Level 3

0 0.25 0.5 1 Miles
0 0.5 1 2 Kilometers

N

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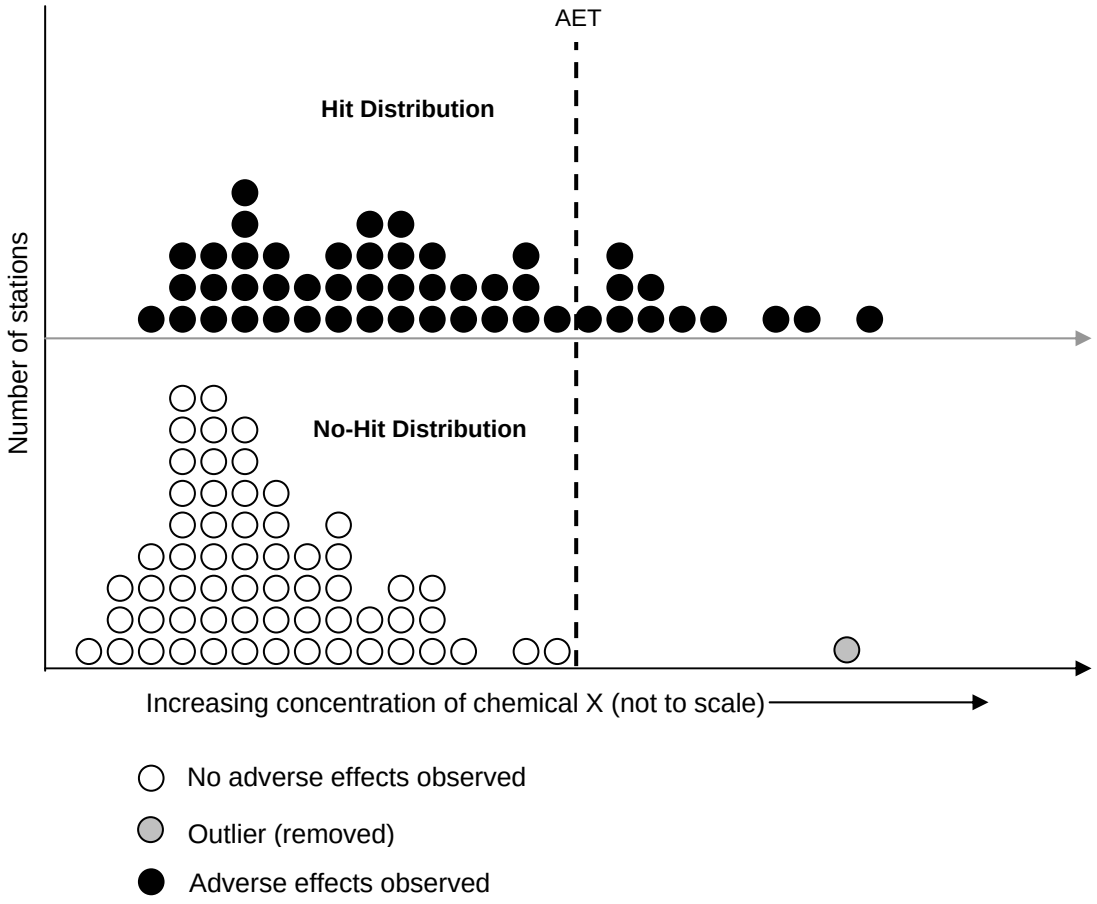


Figure 5-6. Calculation of apparent effects thresholds

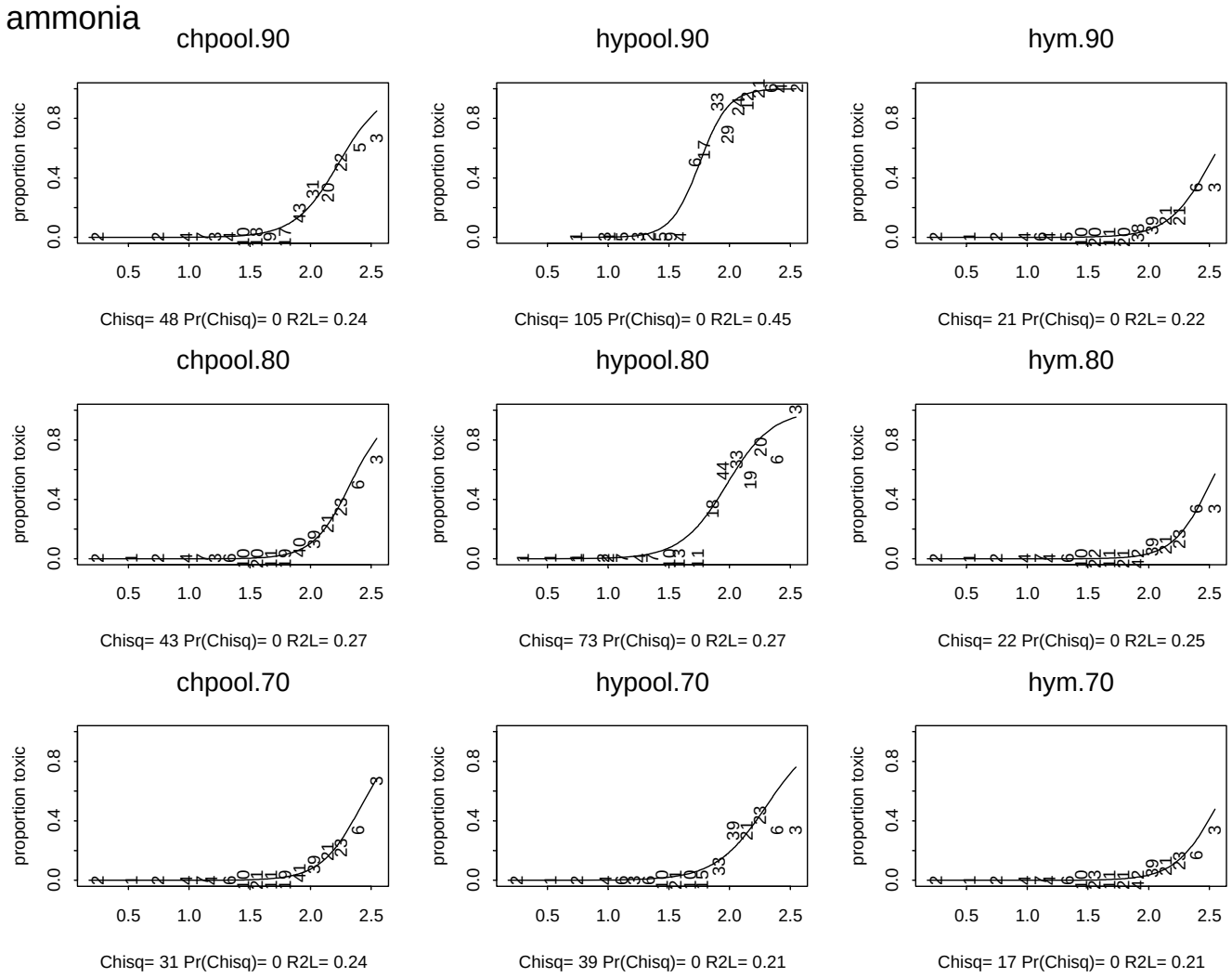
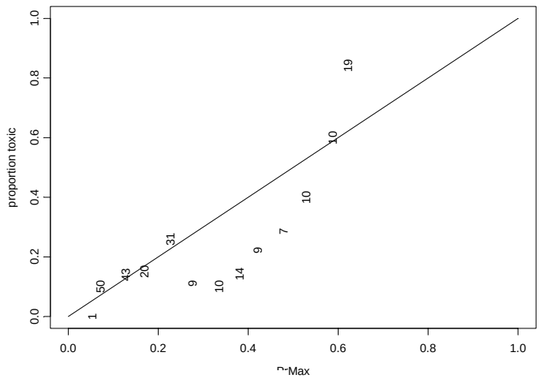
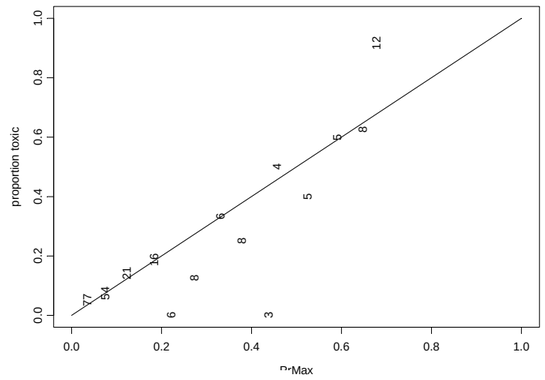


Figure 5-7. Individual logistic regression models for ammonia for three biological endpoints at three effects levels

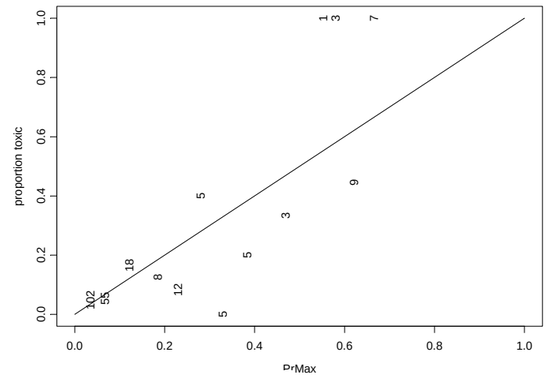
Level 1 *Chironomus* Pooled



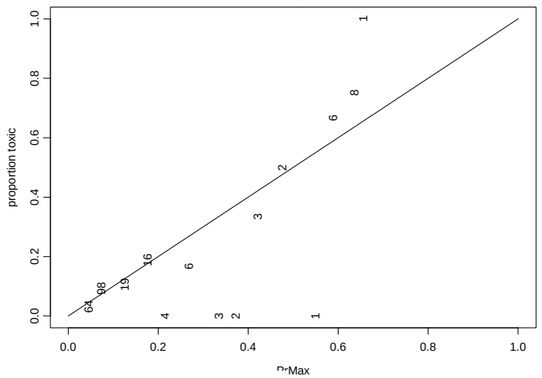
Level 2 *Chironomus* Pooled



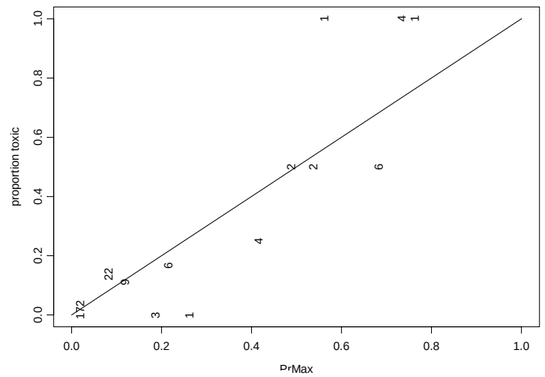
Level 3 *Chironomus* Pooled



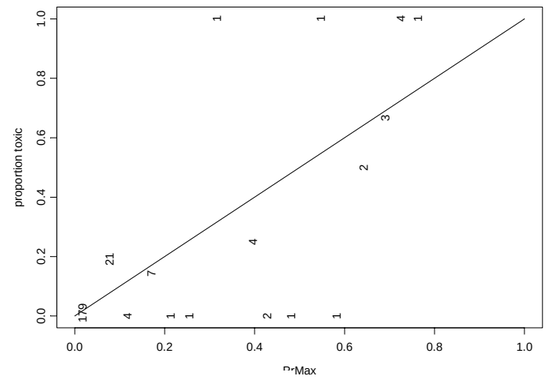
Level 1 *Hyalella* Mortality



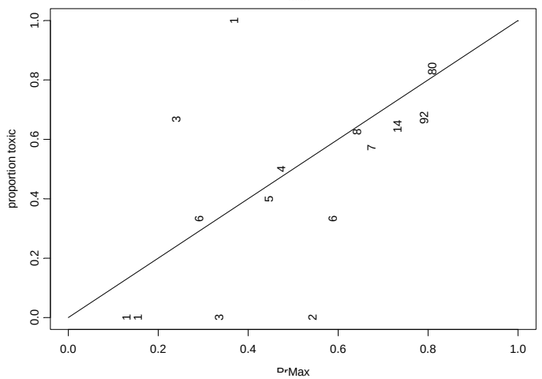
Level 2 *Hyalella* Mortality



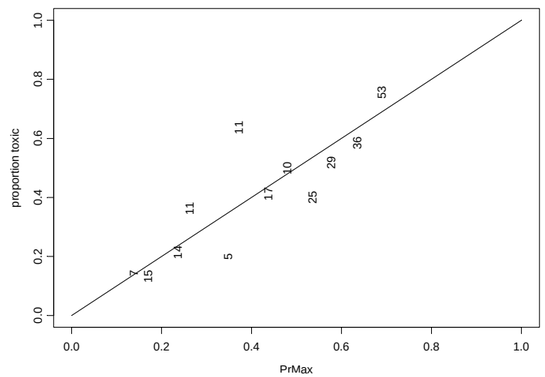
Level 3 *Hyalella* Mortality



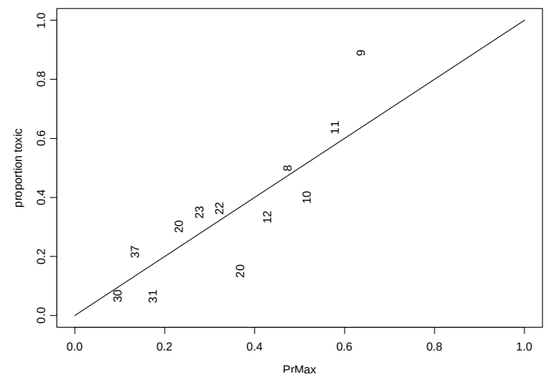
Level 1 *Hyalella* Pooled



Level 2 *Hyalella* Pooled

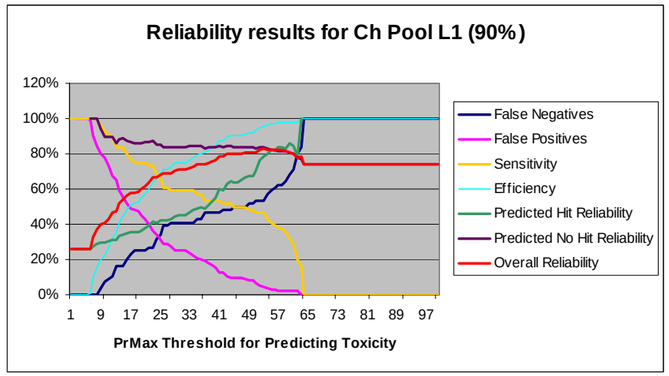


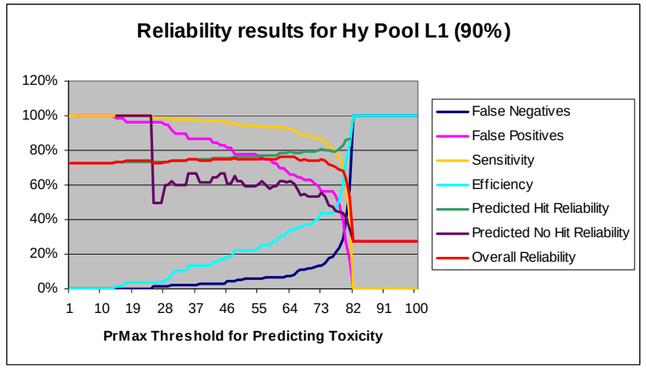
Level 3 *Hyalella* Pooled

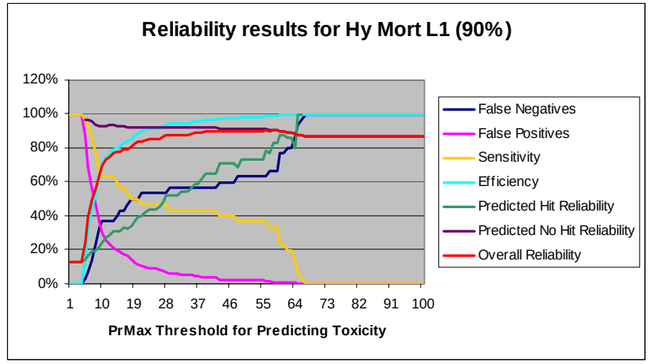


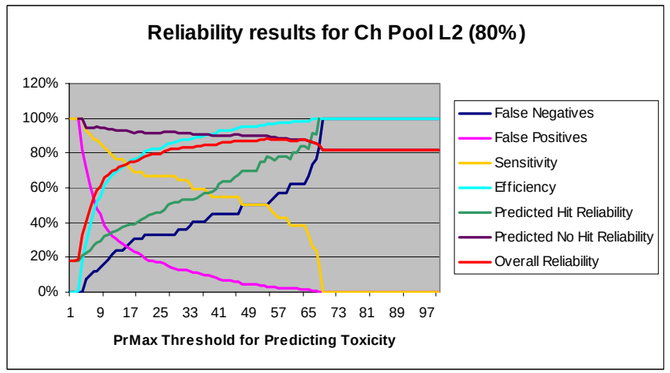
Sample sizes within each PrMax interval are shown as the plotting symbol.

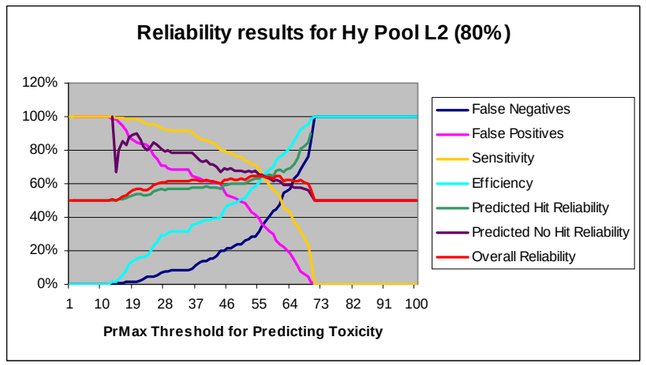
Figure 5-8. Median PrMax value and observed proportion of toxic data within PrMax intervals of 0.05

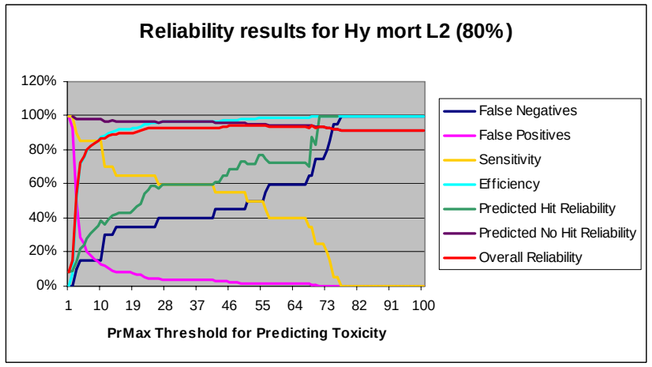


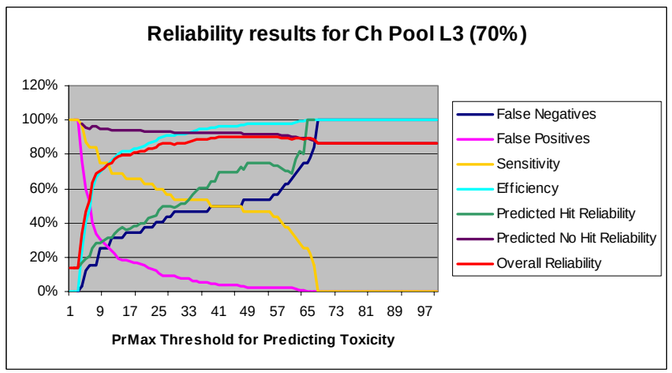


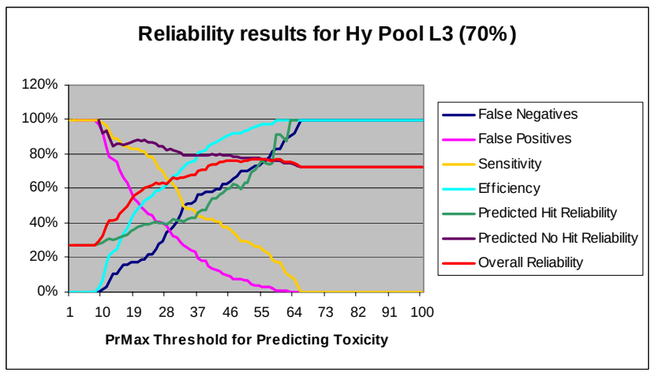












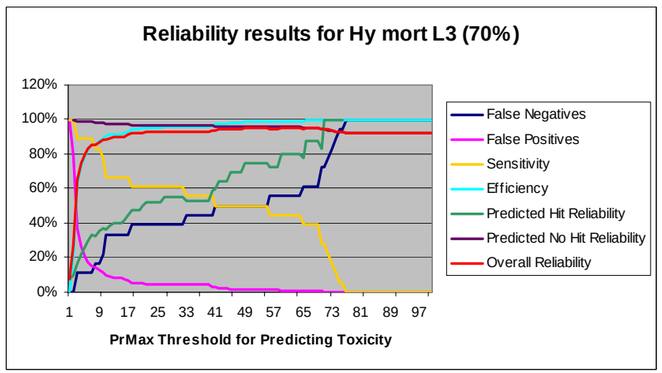


Figure 5-9. Reliability results for three biological endpoints at three effects levels

RM 2
RM 3
RM 4
RM 5
RM 6
RM 7
RM 8
RM 9

Prediction compared to test result at Effects Level 2

Chironomus pooled

Hyalella mortality

False positive

False negative

No error

(Symbols for locations with no errors are allowed to overlap.)

Railroad

Property parcels

Road

Dock or in-river structure

River mile

River and slough

Figure 5-10. Logistic regression model false positive and false negative errors at Effects Level 2

0 0.25 0.5 1 Miles

0 0.5 1 2 Kilometers

N

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RM 2
RM 3
RM 4
RM 5
RM 6
RM 7
RM 8
RM 9

Prediction compared to test result at Effects Level 3

Chironomus pooled
Hyalella mortality

False positive
False negative
No error

(Symbols for locations with no errors are allowed to overlap.)

Railroad
Property parcels
Road
Dock or in-river structure
River mile
River and slough

Figure 5-11. Logistic regression model false positive and false negative errors at Effects Level 3

0 0.25 0.5 1 Miles

0 0.5 1 2 Kilometers

N

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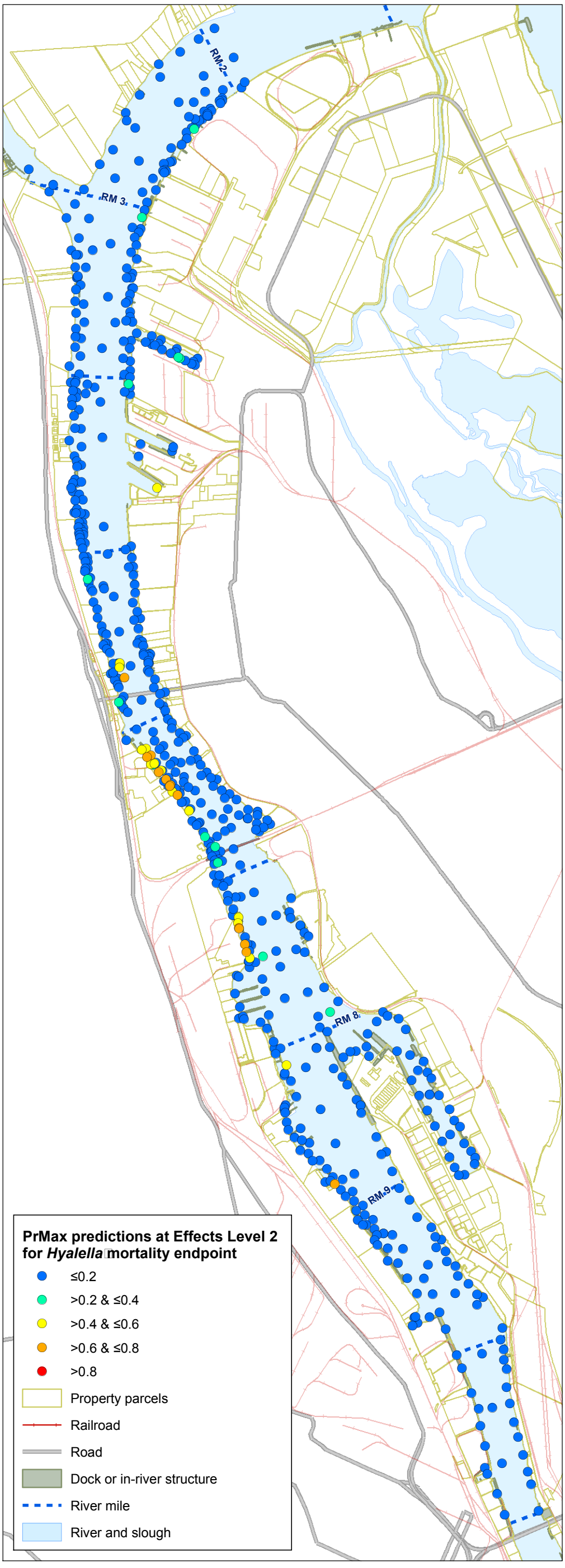

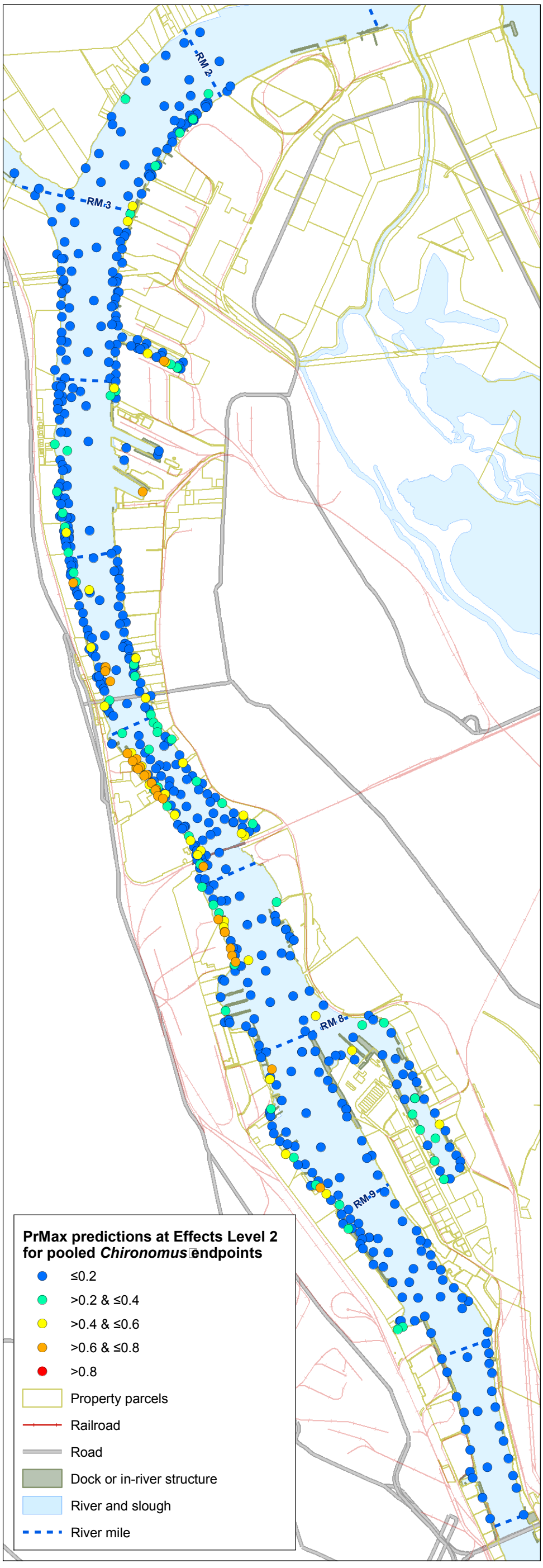

Figure 5-12. Probability of toxicity predicted for surface sediment sampling stations at Effects Level 2 using PrMax from logistic regression models

0 0.25 0.5 1 1.5 Miles

0 0.5 1 2 Kilometers

N

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LRM results based on complete chemical list, including fines as individual predictor; none excluded to reduce errors. Models run and fitted 01/31/06. There are no PrMax values > 0.8.

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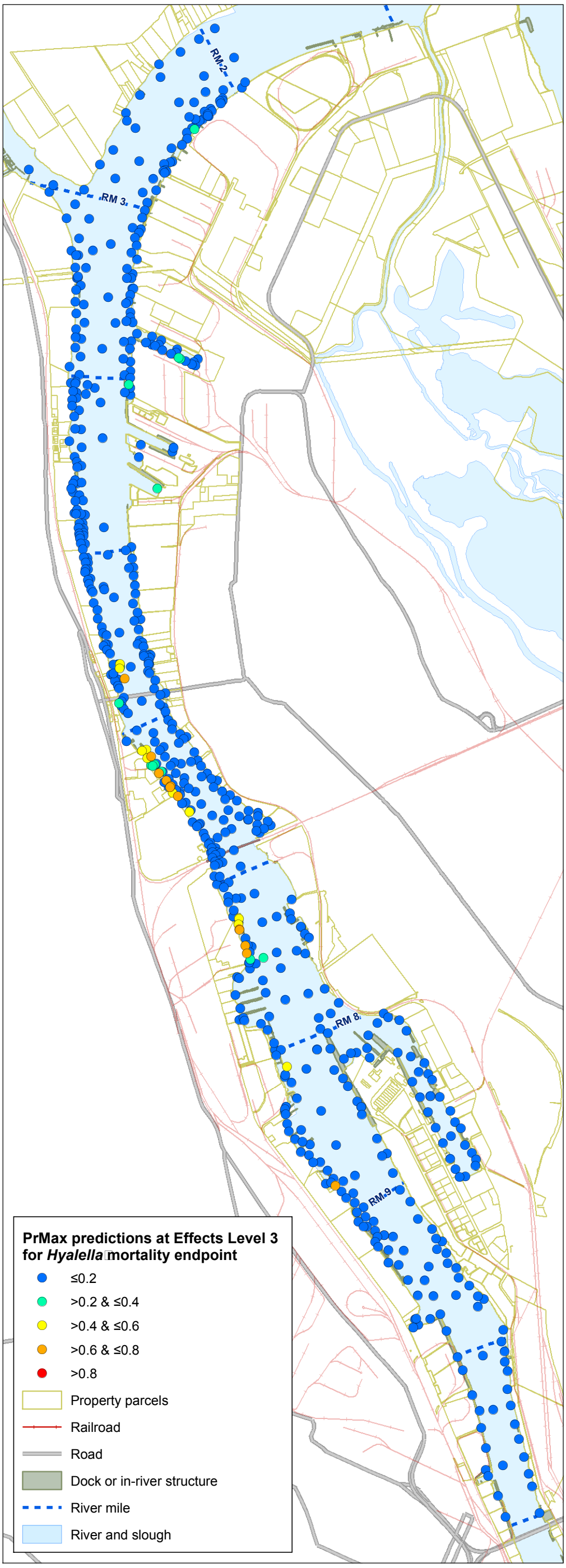

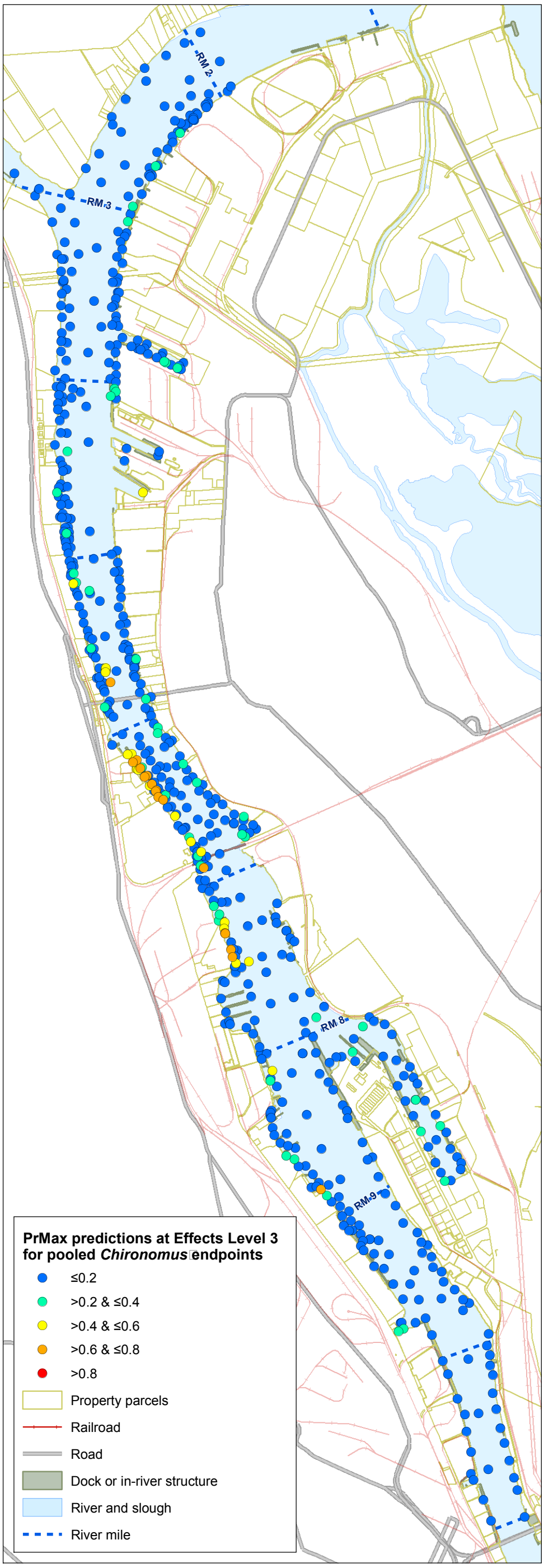

Figure 5-13. Probability of toxicity predicted for surface sediment sampling stations at Effects Level 3 using PrMax from logistic regression models

0 0.25 0.5 1 1.5 Miles

0 0.5 1 2 Kilometers

N

Wind Ward environmental LLC

Prepared by LSM 01-31-06 map 2144

LRM results based on complete chemical list, including fines as individual predictor; none excluded to reduce errors. Models run and fitted 01/31/06. There are no PrMax values > 0.8.

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RM 1
RM 2
RM 3
RM 4
RM 7
RM 8
RM 9

Effects Level exceedance with PrMax at 0.4

- All endpoints below Effects Level 2
- All endpoints below Effects Level 3
- At least one endpoint above Effects Level 3
- Property parcels
- Railroad
- Road
- Dock or in-river structure
- River mile
- River and slough

Figure 6-1. Identification of areas of predicted benthic risk using logistic regression model

Text

0 0.25 0.5 1 1.5 Miles

0 0.5 1 2 Kilometers

N

Wind Ward environmental LLC

Prepared by LSM 2-06-06 map 2146

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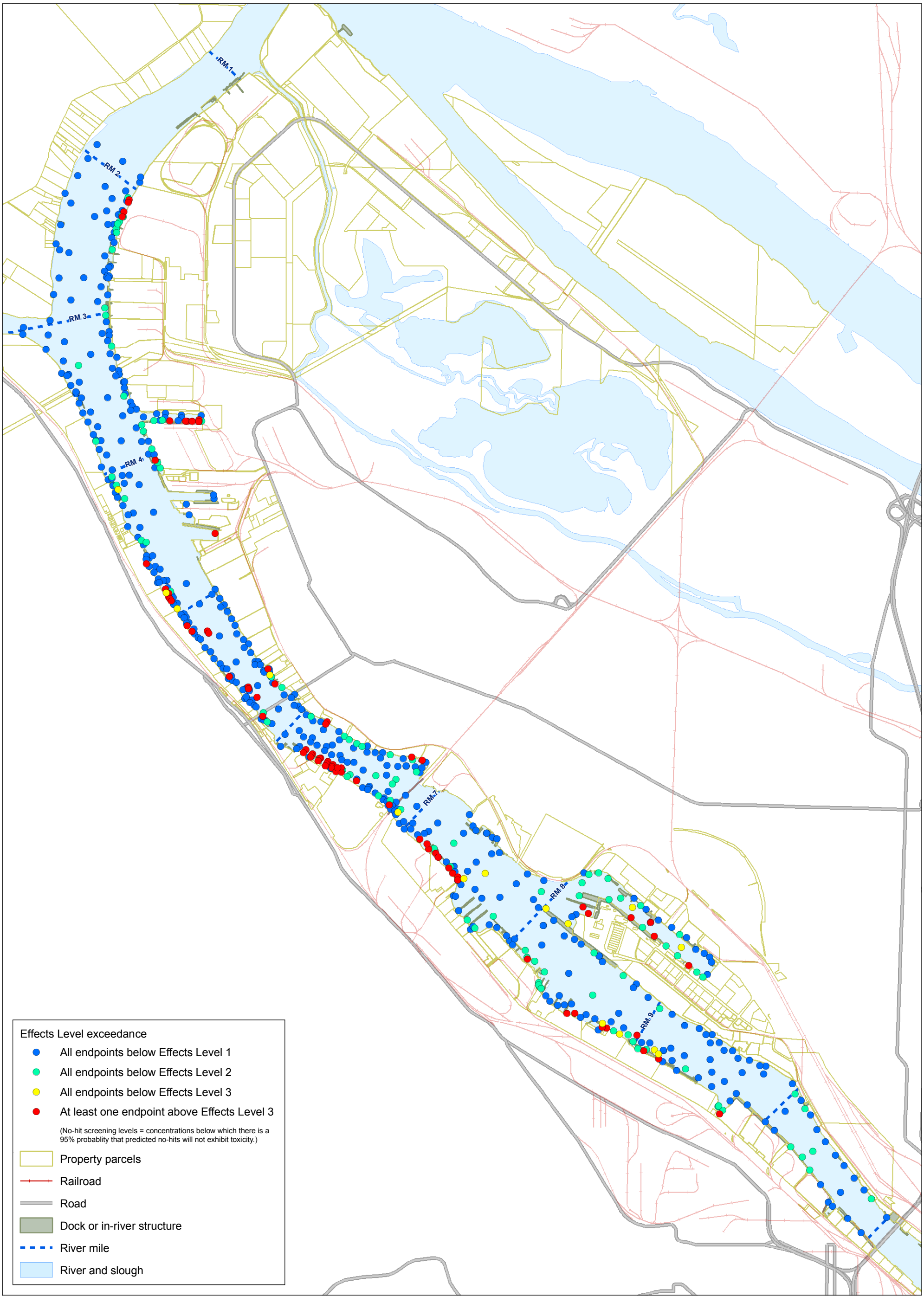

Figure 6-2. Identification of areas of predicted benthic risk using floating percentile model

RM 2

RM 3

RM 4

RM 8

RM 9

Effects Level 2 exceedances for any endpoint;
Chironomus growth or mortality or *Hyalella* mortality

- Exceedance predicted by model
- No exceedance predicted by model
- Exceedance indicated by toxicity test
- No exceedance indicated by toxicity test
- Property parcels
- Railroad
- Road
- Dock or in-river structure
- River mile
- River and slough

Effects Level 3 exceedances for any endpoint;
Chironomus growth or mortality or *Hyalella* mortality

- Exceedance predicted by model
- No exceedance predicted by model
- Exceedance indicated by toxicity test
- No exceedance indicated by toxicity test
- Property parcels
- Railroad
- Road
- Dock or in-river structure
- River mile
- River and slough

Figure 6-3. Sediment quality based on toxicity test results and floating percentile model predictions for both Effects Level 2 and Effects Level 3

0 0.25 0.5 1 1.5 Miles

0 0.5 1 2 Kilometers

N

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Prepared by LSM 02-22-06 map 2191

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